

Auroras were observed during the month as follows: 1st, Webster, Dak. 3d, San Diego, Cal.; Northfield, Conn.; Gardner and Orono, Me. 4th, Fort Buford and Webster, Dak.; Moorhead, Minn.; Fort Assinaboine and Poplar River, Mont. 5th, Cresco, Iowa, and Helena, Mont. 8th, Voluntown, Conn.; Garden City, Parkston, Webster, Bismarck, Fort Totten, and Fort Sully, Dak.; Bancroft, Independence, Monticello, and Wesley, Iowa; Cornish, Me.; Cambridge, Blue Hill Observatory, Milton, Provincetown, and Westborough, Mass.; Mackinaw City, Mich.; Moorhead, Saint Paul, and Saint Vincent, Minn.; Poplar River, Mont.; Berlin Mills, Manchester, and Nashua, N. H.; Garrison, Ithaca and Lyons, N. Y.; Lordstown, Ohio; Erie, Pa.; Green Bay, Wis. 9th, Poplar River, Mont. 10th, Saint Vincent, Minn.; Helena, Mont. 11th, Frankfort, Ky. 14th, Wesley, Iowa. 15th, Saint Vincent, Minn. 17th, Webster, Dak.; Wesley, Iowa; Eastport, Me.; Moorhead and Saint Vincent, Minn. 18th, Fort Buford, Dak.; Eastport, Me.; Poplar River, Mont.; Berlin Mills, N. H. 19th, Webster, Dak., and Poplar River, Mont. 23d, Fort Buford and Fort Totten, Dak.

THUNDER-STORMS.

Thunder-storms were reported as follows: 1st, Willcox, Ariz. 2d, Titusville, Fla., and Tribune, Kans. 3d, Archer, Cedar Keys, Limona, Merritt's Island, and Titusville, Fla.; Quitman, Ga.; Biloxi and Palo Alto, Miss.; Brownsville and Corpus Christi, Tex. 4th, Jupiter, Fla.; Abilene, Corpus Christi, Galveston, New Ulm, and San Antonio, Tex. 5th, Fall Brook, Cal.; Alva, Cedar Keys, Jupiter, Limona, Merritt's Island, Tallahassee and Titusville, Fla.; Quitman, Ga. 6th, Alva, Cedar Keys, Jupiter, Merritt's Island, and Titusville, Fla. 7th, Little Rock, Ark.; Alva, Jupiter, Merritt's Island, and Titusville, Fla.; Liberty Hill, and Shreveport, La.; Fort Sill, Ind. T.; Cedar Hill and Palestine, Tex. 8th, Livingston, Mobile, and Mount Vernon, Ala.; Jacksonville, Key West, Titusville, Jupiter, Pensacola, Duke, Limona, and Merritt's Island, Fla.; Quitman, Ga.; New Orleans, La.; Palo Alto, Miss.; Galveston and Palestine, Tex. 9th, Auburn and New Market, Ala.; Cedar Keys, Key West, Merritt's Island, and Titusville, Fla.; Forsyth, Ga. 10th, Auburn, Mobile, and Montgomery, Ala.; Cedar Keys, Duke, Jacksonville, Merritt's Island, Tallahassee, and Titusville, Fla.; Forsyth, Marietta, and Quitman, Ga.; Palo Alto, Miss.; Columbia, S. C.; San Antonio, Tex. 11th, Cedar Keys, Duke, Jacksonville, Limona,

Merritt's Island, Tallahassee, and Titusville, Fla.; Quitman and Savannah, Ga.; Chicamocomico, Raleigh, Southport, and Weldon, N. C.; Charleston, S. C.; Cape Henry and Norfolk, Va. 12th, Cedar Keys, Jacksonville, Key West, Limona, and Titusville, Fla.; Quitman and Savannah, Ga.; Fort Sherman, Idaho. 13th, Montrose, Colo.; Webster, Dak.; Leon de Aldamas, Mexico. 14th, Fort Verde, Ariz.; San Antonio, Tex. 15th, Fort Verde, Fort Mojave, Tucson, Whipple Barracks, and Yuma, Ariz.; Brownsville, Tex. 16th, Fort Mojave, Whipple Barracks, and Yuma, Ariz.; Keeler, Cal. 17th, Willcox, Ariz.; Concordia, Kans.; Fort Stanton and Lava, N. Mex. 18th, Lebo, Manhatta, and Tribune, Kans.; Fort Reno and Fort Supply, Ind. T.; Conception, Mo. 19th, New Market, Ala.; Lead Hill and Little Rock, Ark.; Cairo, Collinsville, and Palestine, Ill.; Butlerville, Dana, Indianapolis, Jeffersonville, Laconia, Logansport, Salem, Sunman, and Vevay, Ind.; Fort Madison, Iowa; Frankfort and Louisville, Ky.; Liberty Hill, La.; Palo Alto, University, and Vicksburg, Miss.; Frankfort, Saint Louis, and Springfield, Mo.; Cincinnati, Cleveland, College Hill, Jacksonborough, and Wauseon, Ohio; Ashwood, Austin, Milan, Memphis, and Nashville, Tenn.; Palestine, Tex. 20th, New Hartford, Conn.; Augusta, Ga.; New Orleans, La.; Newburyport, Mass.; Biloxi, Miss.; Readington, N. J.; Setauket, N. Y.; Columbia and Stateburg, S. C.; Nashville, Tenn.; Galveston, Tex.; Middlebrook, Va. 21st, Fort Thomas, Ariz.; Cedar Keys and Sebastian, Fla.; Quitman, Ga. 22d, Pensacola, Fla.; New Orleans, La.; Biloxi, Miss.; Corpus Christi, Galveston, New Ulm, and San Antonio, Tex. 23d, Auburn, Mobile, and Montgomery, Ala.; Hot Springs and Little Rock, Ark.; Pensacola, Fla.; Quitman, Ga.; New Orleans and Liberty Hill, La.; Biloxi, Miss.; Cedar Springs, S. C.; Cedar Hill and Galveston, Tex. 24th, Mobile, Montgomery, and New Market, Ala.; Lead Hill, Ark.; Pensacola, Fla.; Quitman, Ga.; Cairo and Palestine, Ill.; Indianapolis, Jeffersonville, Salem, Sunman, Terre Haute, and Vevay, Ind.; Lexington and Louisville, Ky.; Biloxi, Miss.; Cincinnati, College Hill, Jacksonborough, and Yellow Springs, Ohio; Cedar Springs and Columbia, S. C.; Ashwood, Milan, Chattanooga, Knoxville, and Nashville, Tenn. 25th, Wilmington, N. C.; New Ulm, Tex. 26th, Limona, Fla. 27th, Sacramento and Willows, Cal. 29th, Fort Bowie, Fort McDowell, and Yuma, Ariz.; Fort Lewis, Colo.; Sandwich and Sycamore, Ill.; Fort Supply, Ind. T.; Fort Stanton and Lava, N. Mex.; Oswego, N. Y.; La Crosse, Wis.

MISCELLANEOUS PHENOMENA.

FOREST AND PRAIRIE FIRES.

Keeler, Cal., 12th; Fort Sill, Ind. T., 20th to 22d; Fort Reno, Ind. T., 21st; Duke, Fla., 23d.

METEORS.

Pensacola, Fla., a large meteor was observed in altitude 40°, moving from southeast to northwest, at 8.30 p. m. on the 15th. As the meteor fell it increased in brilliancy and exploded when in about altitude 10°; in the flight it left a brilliant trail.

Meteors were also observed as follows: 1st, Lead Hill, Ark., and Keeler, Cal. 2d, Yuma, Ariz.; Rappahannock, Va. 3d, Middlebrook, W. Va. 4th, Biloxi, Miss., and East Portland, Oregon. 5th, Parkston, Dak.; Clear Lake, Iowa. 7th, Wilmington, N. C. 8th, Auburn, Ala.; Lead Hill, Ark.; Clear Lake, Iowa. 11th, Jacksonville, Ill. 13th, Voluntown, Conn.; Wilson and Elkin, Kans. 14th, Readington, N. J. 15th, Pensacola, Fla.; Vevay, Ind.; Clear Lake, Iowa; Tribune, Kans.; La Crosse, Wis. 16th, Lead Hill, Ark.; Wauseon, Ohio. 17th, Wauseon, Ohio. 18th, Yuma, Ariz. 21st, Jacksonville, Ill.; Clinton, Clear Lake, and Keokuk, Iowa. 22d, Independence, Iowa; Rappahannock, Va. 23d, Taunton, Mass. 25th, Rappahannock, Va. 27th, Jacksonville, Ill. 28th, Kalamazoo, Mich.

MIGRATION OF BIRDS.

Geese flying northward.—Fort Bidwell, Cal., 3d, 7th, 24th, 26th; Charlotte, N. C., 3d, 26th; Chattanooga, Tenn., 3d, 26th; Wakefield, Kans., 10th, 29th; Augusta, Ga., 12th; Linkville, Oregon, 15th; Fort Madison, Iowa, 17th; Yankton, Dak., 18th; Crete, Nebr., and Auburn, Ala., 19th; Ames, Iowa, 19th to 24th; Charleston, Ill., 20th; Fort Reno, Ind. T.; Manson, Keokuk, and Osceola, Iowa, 21st; Manhattan and Topeka, Kans., and Portland, Me., 22d; Mesquite, Tex., 24th; Winnemucca, Nev., 26th; Rappahannock, Va., 26th to 28th; Salina, Kans., and Liberty Hill, La., 28th.

Geese flying southward.—Rappahannock, Va., 10th, 19th; University of Virginia, 20th.

Ducks flying northward.—Charleston, Ill., 20th; Crete, Nebr., 22d; Wakefield, Kans., 22d, 29th; Salina, Kans., 28th.

Ducks flying southward.—Duke, Fla., 23d.

Ducks flying eastward.—Little Rock, Ark., 26th; Fort Verde, Ariz., 29th.

Swans flying northward.—Fort Bidwell, Cal., 21st.

MIRAGE.

Mirages were observed as follows: 1st, Parkston and Readington, Dak. 6th, Corpus Christi, Tex. 7th, Yuma, Ariz.;

Corpus Christi, Tex. 11th, Tribune, Kans. 12th, Salina, Kans. 13th, Salina and Tribune, Kans. 14th, Helena, Mont. 17th, Tribune, Kans.; Marquette, Nebr. 18th, Webster, Dak.; Marquette, Nebr. 20th, Salina, Kans.; Fairbury, Nebr. 23d, Marquette, Nebr. 27th, Webster, Dak.

SAND STORMS.

Fort Grant, Ariz., 15th; Willcox, Ariz., 17th, 28th, 29th. Fresno, Cal., 18th. Fort Mojave, Ariz., 18th, 27th; Yuma, Ariz., 19th, 20th. Las Vegas, N. Mex., 29th.

VERIFICATIONS.

INDICATIONS FOR 33 HOURS IN ADVANCE.

The percentages of verifications of the tri-daily indications for February, 1888, as determined from comparison of succeeding telegraphic reports, are given in the table below.

The predictions for all districts east of the Rocky Mountains for February, 1888, were made by 1st Lieutenant H. H. C. Dunwoody, 4th Artillery, U. S. Army, Acting Signal Officer and Assistant, except those for Minnesota and Dakota, which were made at Saint Paul, Minn., by 1st Lieutenant Thomas M. Woodruff, 5th Infantry, U. S. Army, Acting Signal Officer; those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Junior Professor C. F. Marvin.

Percentages of indications verified, February, 1888.

States.		States.	
Maine.....	83.38	Kentucky.....	80.69
New Hampshire.....	84.00	Ohio.....	80.83
Vermont.....	77.66	West Virginia.....	80.66
Massachusetts.....	83.56	Indiana.....	82.66
Rhode Island.....	81.45	Illinois.....	80.34
Connecticut.....	86.24	Lower Michigan.....	80.69
Eastern New York.....	81.31	Upper Michigan.....	77.28
Western New York.....	79.72	Wisconsin.....	82.10
Eastern Pennsylvania.....	81.69	Minnesota*.....	73.97
Western Pennsylvania.....	82.17	Iowa.....	79.59
New Jersey.....	80.79	Kansas.....	84.69
Delaware.....	79.48	Nebraska.....	78.76
Maryland.....	82.93	Missouri.....	80.14
District of Columbia.....	82.10	Colorado.....	81.31
Virginia.....	78.21	Dakota*.....	70.93
North Carolina.....	81.03	Southern California*.....	82.03
South Carolina.....	79.59	Northern California*.....	81.48
Georgia.....	78.52	Oregon*.....	82.89
Eastern Florida.....	78.66	Washington Territory*.....	77.90
Western Florida.....	74.31	By elements:	
Alabama.....	75.10	Weather.....	83.58
Mississippi.....	79.13	Wind.....	77.48
Louisiana.....	78.86	Temperature.....	77.54
Texas.....	79.59		
Arkansas.....	78.83	General average.....	80.55
Tennessee.....	81.38		

* In determining the general average percentage for the different elements, Minnesota, Dakota, and the Pacific coast states have not been included.

CAUTIONARY SIGNALS.

Of the total number of cautionary and storm signals ordered during February, 1888, it was practicable to determine the justification or failure of twenty-eight; justified, twenty-five, or 89.29 per cent. Of the above, twelve were ordered for cautionary signals; number justified, ten, or 83.33 per cent. Sixteen storm signals were ordered; justified, fifteen, or 93.75 per cent. Total number of direction signals ordered, twenty-seven, all, or 100 per cent., of which were justified, five signals being ordered for easterly winds, and twenty-two for westerly winds. Number of storms without signals, thirteen.

STATE WEATHER SERVICES.

The following extracts are republished from reports for February, 1888, of the directors of the various state weather services:

The "Alabama Weather Service," P. H. Mell, jr., of the Agricultural and Mechanical College, Auburn, director:

The month had no special features to distinguish it from Februarys of previous years. Only two cold waves passed over the state, and they were not severe. The average temperature was 2°.4 above the normal. In some portions of the state considerable rain fell, but yet the average was about normal.

The winter has been quite mild, and but few days occurred that were really cold and disagreeable. Rainy days, however, were frequent. The warm days

towards the latter part of the winter brought forth the early buds on the fruit trees and in the forests, but many of the tender germs were destroyed by the cold wave that passed over the state on the 26th of February. There is, however, a good prospect for a fair yield of fruit, because many of the buds were not far enough advanced to be materially affected by the cold snap.

Summary.

Temperature (in degrees Fahr.).—Monthly mean, 51.6; highest monthly mean, 66.1, at Newton; lowest monthly mean, 38.8, at Chattanooga; maxi-

Number of signals ordered late, *i. e.*, after the justifying velocity had begun, eight, or 28.57 per cent.

COLD-WAVE SIGNALS.

Total number of cold-wave signals ordered from Office Chief Signal Officer, one hundred and eighty; justified, one hundred and fifty-five, or 86.11 per cent. One hundred and eighteen cold-wave signals were ordered during the month by the Signal Service Officer at Saint Paul, Minn., of which, ninety-eight, or 83.05 per cent., were justified.

LOCAL VERIFICATIONS.

The following extracts from the published reports of the several state weather services for February, 1888, show the percentages of verification of weather and temperature signals for the various states:

Indiana.—La Grange: the indications received during February were the best and most correct since they have been sent here; 100 per cent. for state of weather and 97 per cent. for temperature were verified.

Seymour: The indications are growing in favor with the people; 87 per cent. were verified.

Michigan.—Weather and temperature signals are now displayed in one hundred and forty-three towns in the state, and on the baggage-cars of twenty-six trains on eight principal railroads of the state.

The indications and cold-warnings are issued by the Chief Signal Officer and distributed to the different stations through the central office. The indications are issued at 1 a. m., daily, from the Chief Signal Office, Washington, and are for the twenty-four hours from 7 a. m. to 7 a. m.

The percentage of verification of these indications for February is as follows (the verification is taken from reports of displaymen furnished this office monthly): weather, 84.8 per cent.; temperature, 81.6 per cent.

The percentage of verification of weather predictions for February on the D., G. H., and M. R'y., is 87.0 for weather, and 81.3 for temperature; on the C. & G. T. R'y., weather, 86.7, and temperature, 88.0; P. H. & N. W. R'y., weather, 90.0, and temperature, 87.0; M. C. R'y., for weather, 88.3, and for temperature, 87.0; G. R. & I. R'y., weather, 83.8, and temperature, 85.0; C. & W. M. R'y., weather, 85.0, and temperature, 88.3; P. O. & P. A. R'y., weather, 90.0, and temperature, 87.0.

Minnesota.—The percentage of verification of weather signals was 80 for weather, and 76 for temperature.

Nebraska.—The percentages of correct predictions for the state are as follows: temperature, 86.2; weather, 83.3; mean, 84.8.

Nevada.—The display of signals at Carson City, which has been done regularly since October 4, 1887, has given great satisfaction to the citizens of that place and vicinity, and so generally have the indications been verified that there is reason to hope that they will be of great benefit to the interests of Nevada.

Oregon.—The weather indications displayed at Albany, Salem, and Roseburg, were verified as to weather 78 per cent., as to temperature 77 per cent. These indications are telegraphed at 2 p. m. daily from San Francisco, and are for the twenty-four hours commencing at 7 p. m. date of receipt of telegram.

South Carolina.—The percentages of verifications of the weather and temperature predictions for the whole state was: for weather, 86.8; for temperature, 90.1.

Tennessee.—The percentage of verification of the daily weather and temperature predictions, issued from the Signal Office at Washington to the various stations were, for the state: weather, 88.9 per cent.; temperature, 88.8 per cent.